FY17 GRC: Shape Memory Alloy Adaptive Cooling

Completed Technology Project (2017 - 2017)

Project Introduction

Thermal constraints are a primary concern for electric vehicles, for both commercial and military applications in both air and spacecraft. Conventional "centralized" cooling methods will not be sufficient to enable many new concepts with demanding decentralized heat sources. Due to the tight integration of the propulsor and the airframe, this challenge is compounded due to stringent volume constraints, boundary layer sensitivity, and close proximity to temperature sensitive composites and electronics. The proliferation of distributed electric propulsion (DEP) vehicles in particular, will require novel cooling techniques that can't be achieved through traditional means. The project goal was to develop SMA actuator mechanisms that open and close cooling paths for electric motors passively without substantially impacting system weight or drag.

Anticipated Benefits

SMA adaptive cooling technology can be integrated directly into an existing propulsor structures, designed to activate only during high-heat operation. This minimizes drops in performance associated with static cooling methods, and doesn't require any active control or external power. This simplifies cooling design for distributed propulsion concepts and highly coupled propulsion airframe integration challenges. Missions with highly variable heat loads no longer have to tradeoff design point performance with peak heat conditions. In the near-term (1-5 years) a performance gain, requiring relatively minimal research costs, can be expected. Over the next 10-20 years, the technology could be retrofitted or implemented on a wide variety of future aircraft and spacecraft; improving performance, while reducing size, complexity and weight. NASA has already identified 23 space and 18 aeronautic SMA applications since 2000, with further potential improvements to aircraft including aerodynamics and noise.

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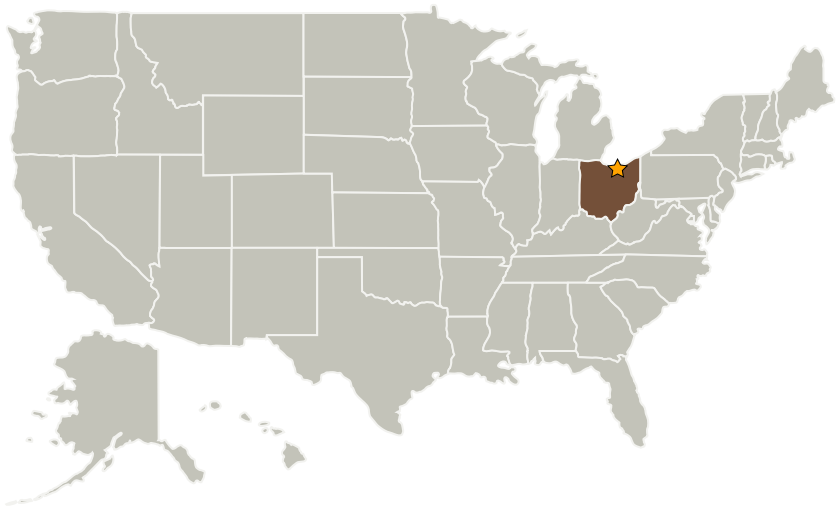
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
Ohio

Project Transitions

May 2017: Project Start

November 2017: Closed out

Closeout Summary: The development of SMA adaptive cooling technologies wil l remain an area of high interest and potential. Future funding opportunities will be pursued to further mature and demonstrate this technology.

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Center Independent Research & Development: GRC IRAD

Project Management

Program Manager:

Gary A Horsham

Project Manager:

Jeffrey C Chin

Principal Investigator:

Jeffrey C Chin

Co-Investigators:

Othmane Benafan
Thomas F Tallerico

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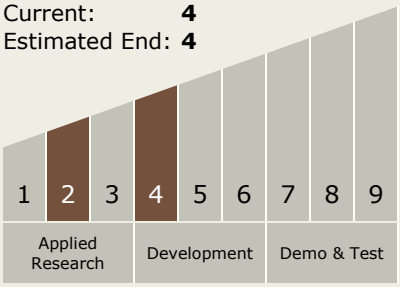
Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors

Target Destination

Earth

Supported Mission Type

Push